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VOL. 82 FRIDAY, AUGUST 30, 1935 No. 2122

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE BODILY EXPRESSION OF HUMAN GROWTH AND WELFARE[1]

By Professor T. WINGATE TODD

WESTERN RESERVE UNIVERSITY AND BRUSH FOUNDATION

WITH all the social changes that have swept over us in the past and are scheduled to smite us in the future there are two intensely human traits so entrenched that nothing will ever dislodge them or even rock them in their setting.

The first is the passion for staring. Vision is preeminently a sense bound up with spacial dimensions and we can not see clearly unless our eyes are stationary. To say that a mother's eyes rest upon her child or that a lover gazes fondly at his beloved is but simple truth. Staring is natural to the eyes and we indulge it long beyond the days of juvenile rebuke. Whether we actually see anything or not is quite another matter and even if we do see there may be considerable doubt as to the correctness of the interpretation. Scientists and laymen alike all crave a good look.

> Full many a time and oft
> Have ye climbed up to walls and battlements,
> To towers and windows, yea and chimneytops,
> Your infants in your arms, and there have sat
> The livelong day with patient expectation
> To see Great Pompey pass the streets of
> Rome.

The second trait is the fascination of bones. The history of the whole world abounds in pilgrimages to bones. Whether they be the bones of those we have loved or the bones of those we have admired, their resting place is forever set apart, a hallowed spot, the Garden of the Unforgotten. Personality clings to the framework of our mortality. The vision of Ezekiel in

[1] Public address delivered at the meeting of the American Association of Physical Anthropologists at Philadelphia, Pa., on April 25, 1935.

the valley of dry bones, the sowing by Jason of the dragon's teeth still conjure up a thrill when they are read. Let these dry bones live! So with Ezekiel's cry in our ears we settle down for a few minutes this evening to have a good look at these imperishable records of life's handicap.

Twenty-one years ago, come September, I was engaged in excavating the skeletons of a poor group of Indians from a mound of rubble on Kelley's Island in Lake Erie. All the village had turned out to see the work. It was a humdrum process of gathering bones. There were no pipes, no ornaments, no evidence of culture, but as we laid bare, one after another, these relics of humanity we came upon one skeleton, in the torso of which lay two little heaps of tiny bones. At once a hush fell over the assembled men and women and all gathered close in the growing twilight, warm with the fragrance of surrounding vines, to hear the story of this nineteen-year-old woman of the Erie Nation whose spirit fled before the birth of her twin babes. There was nothing of high mark in this incident—no splendor, no evidence of the working out of destiny on a grand scale, nothing to touch the chords of the human heart but a woman who had met her fate on the very threshold of life.

On a day in the autumn of 1914 a German fleet bombarded the town of Scarborough on the east coast of England. Considerable damage was done and some of the townspeople were killed, but in the course of the engagement a German shell blew up the coast guard station. That served the useful purpose of removing a government building from a place where it had no business to be and permitted, when the war was over, the excavation of a site where generation after generation of British people had maintained a lookout station ever since Bronze Age times. The Romans had constructed an entrenched camp there, the Saxons a monastery, the Normans a fort, the Plantagenets a castle, the Elizabethans a manor house, the Stuarts a farmsteading, the Hanoverians a coast guard station. And now once more, after two thousand years of occupation, the site was free. And there came to work there Eric Simpson, the explorer of Hadrian's Wall, the bulwark of England against the inroads of my own savage forbears. In 1925, through Mr. Simpson's courtesy and the kindness of Sir Arthur Keith, I studied the skeletons of those who had been laid to rest in the chancel of the Old Church and in the neighboring churchyard during the fourteenth century. There were many skeletons of men from thirty to fifty years of age, soldiery and servitors, no doubt; a skeleton of an elderly woman with a crushing fracture of the skull, an old alewife, perhaps, the victim of a tavern brawl, for women under forty were not allowed to serve strong drink in medieval times. The skeletons of these people differed from those of others in the same locality by the character of their bones, which were stout and rugged, and their teeth, which were early worn as though by coarse food. Other skeletons were slender, with teeth far less worn, though the age, indicated by the articular margins and the texture of the shafts, was not less.

It seemed to me at the time that we were dealing with different social grades, but that view could not be scientifically supported for the simple reason that ten years ago we had no criteria of quality by which to judge the bones. Our studies had to be merely quantitative, confined to the gross determination of mortality statistics.[2] Even this was an innovation, for, at that time, the only collection of skeletons the age of whose possessors at death was known lay in the catacombs of Western Reserve University. These skeletons of our fellow townsmen we had gathered from 1913 onwards and carefully preserved with full documentation of all that was known about the owners during life. By studying these we hoped to be able to assess the age at death of skeletons whose origin was unknown. Nowadays Terry has a similar though less extensive collection at Washington University in St. Louis. But so far as I know, these are the only two institutions where complete human skeletons of known age are readily available in large numbers for study.

Perhaps the most easily observed evidence of age is to be seen in the shoulder blades by the method of trans-illumination introduced by Dr. Graves.[3] Whereas the blades of these bones, in young adults, are of uniform translucence, with definitely patterned vascular tracts and no muscular ridges, as age increases the translucence becomes patchy, owing to the thinning of some areas and erratic thickening of others, which mutilates the vascular patterns. The so-called muscular ridges also increase in stoutness and robusticity, so that in old people they become most striking, a period of life, of course, when muscular strength has long been in decline. The full story of age characters in the skeleton as shown in these two great collections has never yet been fully recorded, but it is to be hoped that this will eventually be done for the sake of those who are faced with the practical problems of age determination on skeletal material.

The characters of age between twenty-five and forty-five are largely to be found in the development of beadings or rims to the articular surfaces of bones, though the condition of sutures on the inner surface of the brain case is of material assistance.[4, 5] The

[2] T. W. Todd, *Scientific Monthly*, 24: 481–496, 1927.
[3] W. W. Graves, *Am. Jour. Phys. Anthrop.*, 5: 21–33, 1922.
[4] T. W. Todd and D. W. Lyon, Jr., *Am. Jour. Phys. Anthrop.*, 7: 325–384, 1924.
[5] *Ibid.*, 8: 47–71, 1925.

sutures on the outer surface are not dependable, though they may give accessory information.[6, 7]

After forty-five years of age changes are mainly nutritional in character and depend upon a redistribution of the mineral of the body whereby it is removed from the bones and deposited in joint fringes and articular cartilages. Almost every one over the age of fifty shows this rarefaction, first in vertebral column, ribs and feet, but eventually spreading to all parts of the skeleton, including the skull. Professor Karl Pearson's recent monograph on Oliver Cromwell's head shows the patchy rarefaction, visible in a roentgenogram of the skull-cap like grains of translucent sago, characteristic of a man of about sixty years in poor bodily nutrition.[8]

Essentially the passage of time is recorded in an adult skeleton by the occurrence in corresponding degree of those features which are the inevitable trail of disturbances in health. This means of course that those who have finally succumbed to a long siege of disease will bear in their skeletons the characters usually found only in individuals of much greater age. It is not very unusual to find a skeleton, actually of thirty years, which to the unwary would indicate fifty years. A check of the more youthful features of the articular rims against the more senile features of the bone texture will usually prevent this mistake. Contrariwise, the robust healthy aged are characterized by bone textures far more youthful than the age would lead one to anticipate, whereas the articular margins present undoubted evidence of seniority.

Many days spent together in the catacombs of Western Reserve University in the study of skeletons from men and women whose clinical history we knew has led Dr. Graves and myself to the conception of quality in bodily tissue. It would ill become me to dilate further upon this subject at the moment, for Dr. Graves is engaged in a far more comprehensive statement on those features which have an age incidence, a biological significance and a survival value. We are only at the beginning of the elucidation and, as Dr. Graves insists, must use the age incidence principle until a better means is found.

Quality of tissue is not merely a result of the health or sickness adventures which one meets during one's lifetime. It is expressed in the reaction of the body to onslaught, but is evident at all ages from birth upward, and the origin must be traced back into prenatal life even to the genes which convey to us our inheritance. It is this permanent character of tissue quality which Dr. Graves has so patiently and persistently emphasized.[9] His illustrations have in the main been drawn from shoulder blade form. Quality is already discernible in prenatal life and survival value is vividly portrayed by the finding that in any particular age period there are to be found from one and one-quarter to two and one-quarter times as many convex or "better quality" shoulder blades in healthy as in sick groups.

This does not mean that poor quality must inevitably succumb or better quality survive. Medical science and social hygiene have prolonged the life and usefulness of many an individual who has been unfortunate in his choice of ancestors. But this does not make less laudable our efforts to improve the quality of human inheritance.

So far we have discussed the expression of quality in the adult, but we now see that quality is already established very early in our individual history and we turn therefore to a consideration of quality in childhood.

A few months ago my colleague, Dr. Krogman, wrote a quite fascinating account of two children whose skeletons were recovered from an "Indian Mound" in Missouri.[10] Not only was it possible to give an approximation of stature and age but of health history and the effect of sickness upon the growth pattern.

In the child as in the adult we have tangible evidence of progressive maturity or age characters, but we also encounter the features of growth or increase in dimensions. It is these increasing dimensions which confuse our interpretation. The word growth usually implies both increase in dimensions and progressive maturity, but since we do not apply the term to the adult it is clear that growth does not really include progressive maturity, which may proceed at a totally different rate. Nature is comparatively careless of stature, permitting it to vary within relatively wide limits, but zealously keeps the program of maturation as nearly as possible to schedule. There are circumstances, however, in which the maturation program lags, whereas stature proceeds at usual or even more than usual speed. While disharmony of progress between growth and maturation may, in rare cases, reach pathological extremes it is by no means infrequently observed in more moderate grade. We therefore see children who are tall or short for their age, advanced or retarded in physical development for their years.

Jackson's experiments of many years ago on rats showed that if the animals were underfed in early life they continued to grow but modified their form

[6] *Ibid.*, 8: 23–45, 1925.
[7] *Ibid.*, 8: 149–168, 1925.
[8] K. Pearson and G. M. Morant, *Biometrika*, 26: 269–378, 1934.
[9] W. W. Graves, Scientific papers of the Third International Congress of Eugenics, N. Y., pp. 457–482, 1932.
[10] W. M. Krogman, *Am. Anthrop.*, 37: 92–103, 1935.

so that transverse dimensions lagged more than longitudinal ones. These underfed rats were ultimately a little shorter and much more slender than their controls.[11] This is a very important observation, but it does not necessarily mean that underfeeding directly acts to bring about change of proportions: it means that underfeeding modifies the mechanism of growth control and thus brings about the same end result which might be expected from any form of bodily malnutrition.

During the past twenty years these experiments have been extended, and Jackson now reports further that animals which have survived a period of underfeeding and have then lived a healthy life on a well-balanced diet do recover a normal weight in their internal organs, but not in their skeleton.[12] The organism is restored as a functioning mechanism, but in its framework it bears the scars of misadventure.

I have often mentioned that the work of the Bakwins in New York shows how children, undernourished from gastro-intestinal disorders, present the same slender proportions[13]; and how Boas' classical work on the measurement of immigrants and their children illustrates this slenderness of malnutrition in the face.[14]

That the face is very susceptible to malnutrition from whatever cause is evident from the work of Wharton and myself on the sheep,[15] but the proof of its occurrence in the faces of children has been given by Broadbent.[16] Defective growth of face during the first year of life is by no means uncommon: the astonishing thing is the resiliency of growth and compensatory increase in rate during the period of convalescence by means of which adjustments are made and thus a permanently misshapen form avoided.

Two other features characteristic of early undernourishment are the failure of brain[17] and eyeballs[18] to reach normal size subsequent to the starvation period. These organs alone apparently of all the viscera are specially susceptible to injury of growth capacity from undernourishment.

One would not wish to emphasize too vigorously the lessons taught by these experiments on rats. Two points, however, are significant. First, we may expect the framework of the body to carry in its structural form the scars of misadventure, and secondly, the organ which is most susceptible to injury in early life is the brain with its derivatives, the eyeballs.

If, however, the actual dimensions of the body suffer disturbances of growth capacity and viscera, with the exceptions mentioned, do not, we may well wonder what happens to the maturation progress. Again Jackson has given us important experimental evidence.[19] The nubbins of cartilage on the ends of young bones begin to ossify as early in the undernourished animals as in the normal controls. Maturity pattern runs along with visceral growth and not with dimensions of bodily frame. This is precisely what should be expected, for visceral growth implies functional adequacy to the task, whereas mere bodily size is in no way indicative of bodily efficiency.

Realizing this fundamental principle many investigators have sought to utilize the roentgenographic appearances of the maturing articular ends of bones as indicators of the progress of maturation in the body as a whole. Most have been discouraged by what seem to be marked individual variations and discrepancies. If, however, one will realize that these progressive stages in maturation, obvious enough in bones by roentgenographic methods, have no direct relation to growth but are a measure of metabolic integration and that discrepancies mean functional inadequacy, most of the difficulties of interpretation vanish. Just as there are asymmetries of growth due to inequalities in dimensional increases, asymmetries which may themselves register successful compensations in structural form, so there are discrepancies in maturation progress to be found in different parts of the skeleton of growing children. These discrepancies, when they occur, may make it very difficult to assess the precise stage of maturation to which the child has attained. But that in itself may also be most illuminating and helpful in our effort to interpret or explain the child's behavior pattern. Obviously, a child with an experience characteristic of ten years, with a growth in size average for ten years and the aspirations, interests, cravings and aversions inseparable from a maturity typical of ten years is going to behave in far different fashion from one, whatever his stature, whose experience of ten years is the sole governor of the whims and yearnings typical of a thirteen-year maturity level. Here, then, is one of those causes of turmoil in the young at which we who are older stand in increasing amaze in measure with our encumbering years.

I have given an example from the type of child whose very excellence is his undoing. But there are

[11] C. M. Jackson, *Jour. Exp. Zool.*, 19: 99–156, 1915.
[12] C. M. Jackson, *Anat. Rec.*, 61, suppl.: 28, 1935.
[13] Harry Bakwin and R. M. Bakwin, *Jour. Clin. Invest.*, 10: 370–403, 1931.
[14] Franz Boas, "Changes in Bodily Form of Descendants of Immigrants," 113 pp. Government Printing Office, Washington, D. C., 1910.
[15] T. W. Todd and R. E. Wharton, *Am. Jour. Anat.*, 55: 97–116, 1934.
[16] B. H. Broadbent, "Features of Dento-facial Growth Significant to the Dentist." Am. Dental Assn. Chicago, August, 1933. In course of publication.
[17] C. M. Jackson, *Jour. Exp. Zool.*, 19: 99–156, 1915.
[18] C. M. Jackson, *Anat. Rec.*, 61, suppl.: 28, 1935.
[19] C. M. Jackson, *Jour. Exp. Zool.*, 19: 99–156, 1915.

unfortunately too many whose handicap results not from excellence in one particular but from a growth capacity disorganized by illness, by privation or by economic distress in years gone by. It is an easy thing to tell the age at which a friend with pitted teeth must have suffered from infantile disturbance. It is not yet generally understood that the frequent decay of the six-year molars or of the wisdom teeth could also have been forecast and prepared for years before. These susceptibilities to disease are but the working out of destiny which was already set in earlier childhood. So far we know but little on this most important subject, but the day will come when it will be possible to predict (and budget) for the trials which the growing child is destined to encounter at definite stages of his career.

Time passes or we might enlarge on this subject and press its consideration backward into prenatal life, in which phase of existence, as Dr. Job has recently shown,[20] assaults upon the growth patterns are just as definite and certain in the specificity of their results as are the adventures of postnatal existence.

So far we have considered the individual, child or adult, from the points of view of growth and maturation or differentiation, as Brandt[21] would have us call it. We have not yet taken up the formative influences which loom so large in our hereditary pattern.

Heredity is a little elusive in character. When it is mentioned we are apt to think of fruit-flies or mice, and we console ourselves with the thought that our president's neat experiment involving three hundred generations must be far removed from folk for whom, were it tried, 9,000 years would be necessary.[22] We also perhaps congratulate ourselves that this experiment showed the strength of a stock endowed with what might be called superior quality against the constant sapping from misguided matings.

The most practical way to look at heredity to-day is not in genealogies of feeble-minded or physical defect but in the family growth patterns. Heredity is a broad stream, and these formative influences inherent in our genes allow us plenty of latitude. Hence there are marginal members in most families, outsize or peculiar in gait, habit or attitude, persons to whom a double portion of inheritance has been allotted.

The only practicable way to study these family patterns is by the method of long-term observation, for the characteristic features, though inherited, may not show themselves till late in childhood or even until adulthood. The accumulation of longitudinal records of many family growth patterns in our studies on childhood and adolescence in the Developmental Health Inquiry on which we have been engaged in Cleveland has given us illuminating and suggestive data on this problem. It is not always easy to refer vagaries in the pattern directly to the formative influences of heredity, but when one sees child after child of the same family showing the same peculiar features of the pattern differing only in degree, not necessarily indeed at the same age but always at the same stage of maturation as registered in the roentgenographic records of the skeleton, one must allow that some influence characteristic of that family inheritance is responsible. As Professor Pearl points out[23] it has been learned from animal breeding that the only reliable measure of genetic superiority is the progeny test, the test of the quality of the offspring actually produced. This fundamental truth is the hope of our salvation, for the vast majority of the most superior people in the world's history have in fact been produced by mediocre or inferior forbears. Professor Jennings has been at great pains for many years to emphasize that what one inherits is certain material that under certain conditions will produce a particular characteristic. If those conditions are not supplied, some other characteristic is produced.[24, 25, 26]

Family patterns evident in performance, adaptation and survival are, as Graves insists, the basic formulators of our social life. Fitness problems of the community or the race must ultimately find their solution in the progeny test, the effective moulding of the family pattern. Homogeneous communities are defined by Herskovits[27] as those in which the range of variation falls within the limits of the family pattern.

How great may be the differences of family pattern in heterogeneous communities of complex racial origin or social grade we shall not know until the problem of the family pattern has been subjected to intensive study. For America we have a bare beginning, for other countries none at all. The evidence gathered with painstaking thoroughness by Cobb[28] shows that the bodily features in which the full-blooded Negro differs from the White are chiefly proportions of limbs and torso and of cranial architectural pattern. In fundamental bodily characters and

[20] T. T. Job, *Am. Jour. Anat.*, 56: 97–117, 1935.
[21] Walter Brandt, "Grundzuge einer Konstitutionsanatomie." 382 pp. Julius Springer, Berlin, 1931.
[22] Raymond Pearl, *Science News Letter*, 27: 196, 1935.
[23] *Science News Letter*, 27: 196, 1935.
[24] H. S. Jennings, "Prometheus, or Biology and the Advancement of Man." N. Y., 86 pp. (see p. 43), 1925.
[25] H. S. Jennings, "The Biological Basis of Human Nature." N. Y., 384 pp., 1930.
[26] C. Kirkpatrick and G. Cedarstrand, *Human Biol.*, 5: 371–384, 1933.
[27] M. J. Herskovits, 21st Internat. Cong. of Americanists, pp. 5–12, 1924. See also *Jour. Am. Statistical Assn.*, 30: 380–389, 1925.
[28] W. M. Cobb, *Jour. Negro Ed.*, 3: 340–388, 1934.

developmental patterns the American Negro is identical with other types of modern man. But these are observations made on the end results of growth as found in adults. The only meager documents of the growth pattern itself are found in those records provided by the Brush Foundation for the White House Conference on Child Health and Development in 1930, records which compare the growth patterns of Cleveland White and Negro children, children of American-born parents and of Sicilian-born parents.[29] Hopelessly inadequate though these samples are, they suggest that differences of pattern relate only to proportions and size of body frame-work, not to fundamental pattern of maturation. They bear out Cobb's summary derived from observation of the adult. In the dispassionate consideration of plans for the promotion of human welfare there is but one test of validity. Do they contemplate a cultural system to which man is to adjust himself as best he can or are they the spontaneous outgrowth of the insistent yearnings of human nature, securely rooted in the biological characters of mankind. Our observations to-night point the way to an enchanting study of prime significance for social welfare in a field of work where few have trod and none has set a master furrow. They are but a rushlight in the stormy night of chaotic current social theory, but they illuminate, however feebly, the crucial fact that man's biological nature is so deeply ingrained that political or social schemes which overlook this fact will do so at their peril.

SCIENTIFIC EVENTS

HYDROGRAPHY IN THE BRITISH ADMIRALTY

ACCORDING to the London *Times*, it has been decided that the British Admiralty shall undertake the construction of a magnetic survey ship, which is urgently required to carry out magnetic observations at sea, and provision for commencing the work has been made. The construction of the ship is necessary to determine the secular change in magnetic variation at sea, and thus to provide accurate forecasts of the correction to be applied to the standard, *i.e.*, the magnetic compass, in all ships.

Up to 1929 these observations were made by a ship belonging to the Carnegie Institution of Washington. Unfortunately, this vessel was destroyed by fire in 1929, and the institution has decided not to replace her.

According to the *Times* it is of special importance to Great Britain, as the principal maritime nation of the world, that a vessel should be built to resume the work with the least possible delay.

During 1934 H.M. surveying ships have all been fully employed in making new surveys or resurveys as necessary, the number of ships employed being four at home and four abroad. Of the latter, one has been employed in the Far East, one on the coast of Siam, one in the Persian Gulf and Cyprus and one in the West Indies and on the coast of Labrador. The party left in Labrador during the winter of 1933–34 were reembarked by the *Challenger* in July last, having accomplished a considerable amount of work. Owing to more urgent requirements, the Labrador survey will not proceed for the present.

The tidal stream survey of the British Isles has been continued in collaboration with the French and Netherlands Governments; assistance has also been given by the Fishery Board for Scotland and the Northern Lighthouse Board. Satisfactory progress is being made, and data have been collected at some sixty stations during the year.

Further developments are taking place in both deep and shallow echo-sounding apparatus, which continue to give highly satisfactory results. The development of a boat set has enabled echo-sounding methods to be employed by the motor-boats of surveying ships, and areas to be surveyed can thus be covered in a much shorter time, since echo-sounding does not, as does the use of the sounding machine or the hand lead, involve the stopping of the boats. The development of visual recorders, which enable a trace to be made of the sea bottom, has also been considerably advanced.

THE SECOND DOLAN EXPEDITION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

WORD has been received at the Academy of Natural Sciences of Philadelphia to the effect that the second Dolan expedition to West China and Eastern Tibet, led by Brooke Dolan, II, of Philadelphia, which was for several months completely cut off from mail and other ordinary means of communication, had rounded out its first year of exploration and collecting with much new and valuable scientific data and many specimens of rare and unusual birds and mammals for the study collection of the museum.

To secure necessary official permits for work in certain remote areas, Mr. Dolan left the main party and with two Tibetans journeyed from Jyekundo to Sining, through the so-called "Never-never Land" of the nomad tribes who roam these high mountain sources

[29] T. W. Todd, "Growth and Development of the Skeleton," in "Growth and Development of the Child." Pt. II, "Anatomy and Physiology," pp. 26–130. Century Company, N. Y., 1933.

of the upper Yellow River, a region last traversed by foreigners many years ago, and then only with an organized caravan.

These bleak wind-torn steppes averaging 14,000 feet above sea-level are almost grassless, and take a heavy toll from such merchant caravans as venture between Jyekundo and Sining. Caravans are always heavily armed against marauding bands of Ngolok nomads, and Mr. Dolan reports a narrow escape from an engagement with such a band. The wastes are almost trackless, and for nine days the small party was lost with a failing food supply. However, an extensive survey of the animal and bird life was made for the first time, and an excellent view obtained of an almost unknown snow peak, Amnyi Machen, which, contrary to previous observers, Mr. Dolan judged to be less than 25,000 feet high and not comparable to the giants of the Himalayas.

Along the Ussu tributary of the upper Yangtse River in northeastern Tibet the expedition collected specimens of wild yak, Tibetan antelope and big-horn sheep, secured with a view to new habitat groups in the museum. Besides these, many other mammals and birds have been collected and prepared for shipment to Philadelphia.

VISIT OF BRITISH PHYSICIANS TO THE UNITED STATES

THE *Journal* of the American Medical Association states that fifty-five British physicians, with members of their families, making a group of 110, visited, between August 4 and 14, New York, Washington, Chicago, Albuquerque, the Grand Canyon, Los Angeles and San Francisco, on their way to the meeting of the British Medical Association, which will be held in Melbourne, Australia, in September. On their arrival in New York on the S.S. *Georgic,* on Sunday, August 4, the visitors were met by Drs. Morris Fishbein and Austin A. Hayden, Chicago, and Arthur W. Booth, Elmira, N. Y., representing the American Medical Association, and by Drs. Frederic E. Sondern, New York, and Arthur J. Bedell, Albany, president and immediate past president, respectively, of the Medical Society of the State of New York. On Sunday afternoon the guests were taken by motor to Grasslands Hospital, Valhalla, N. Y., with a special police escort. Monday, August 5, was spent in visits to the Columbia University-Presbyterian Hospital Medical Center, the New York Hospital-Cornell Medical Center, the Rockefeller Institute for Medical Research and other points of interest, with a luncheon at the Waldorf-Astoria. On the following two days the party saw the sights of Washington, D. C., and Mount Vernon. They were received at the White House and entertained at a reception at the British Embassy. They were also guests at a luncheon at the Mayflower Hotel, at which officials of the Army and Navy Medical Corps, the U. S. Public Health Service, the British Embassy and the Medical Society of the District of Columbia were hosts. Arriving in Chicago on August 8, the day was spent viewing places of interest in the city. The party was accompanied by Dr. Hayden, who was in charge of arrangements for the day; Dr. Olin West, secretary of the American Medical Association; Dr. Fishbein; Dr. Thomas P. Foley, president-elect; Dr. Robert Hayes, secretary of the Chicago Medical Society, and Dr. Lemuel E. Day, member of the council of the Illinois State Medical Society. At the Union Stockyards G. H. Swift, together with medical and other officials of the firms of Swift and Company, Armour and Company and Libby, McNeill and Libby were hosts at a luncheon for the visitors. At a tea at the Edgewater Beach Hotel, Robert Ross, acting British consul in Chicago, and representatives of the various official bodies made addresses, to which Dr. Ernest Kaye Le Fleming, chairman of the council of the British association, responded. In the evening the party was entertained at dinner. During the day Professor Ernest W. Hey Groves operated at Cook County Hospital. Sir Comyns Berkeley, Sir Ewen MacLean and Professor John Bright Banister visited the radium centers at Michael Reese Hospital and the Chicago Lying-in Hospital.

At midnight the party left on a special train for Albuquerque, N. M., where they were entertained by the Bernalillo County Medical Society, with visits to the University of New Mexico and the Indian village of Isleta. A day was spent at the Grand Canyon as guests of the local medical society. Los Angeles was visited on August 12, with the Los Angeles County Medical Association acting as host. On August 13, the daylight coast line trip to San Francisco was taken, the entertainment being arranged by the County Medical Society. In the afternoon the party embarked for Australia. It was planned to stop one day at Honolulu, where the Hawaii Territorial Medical Association and the Honolulu County Medical Society planned entertainment, including sightseeing trips around the island of Oahu and a dinner at the Royal Hawaiian Hotel, with special Hawaiian music and dancing.

THE AMERICAN FORESTRY ASSOCIATION

THE 1935 annual meeting of The American Forestry Association, which will mark its sixtieth anniversary, will be held at Lake Placid, New York, on September 12, 13 and 14, in coordination with New York's state program to celebrate fifty years of conservation. The two meetings will form one of the greatest conservation rallies in many years. President Franklin D. Roosevelt and Secretary of Agriculture Henry A. Wallace have been invited to participate.

Plans for the anniversary meetings call for a series

of field trips and sporting events interpolated with talks by eminent men. Opportunity will be given those in attendance to view at first hand some of the accomplishments of New York State since the creation of a forestry commission and the forest preserves fifty years ago—the real beginning of state forestry in the United States—and to hear conservation leaders discuss future trends and policies. The headquarters of the meeting will be in the Arena, at Lake Placid, where many of the sessions and events will take place.

A meeting of the New York Section of The Society of American Foresters, which will be open to all attending, bait-casting contests and a championship baseball game between Civilian Conservation Corps teams will be held on the opening day. In the evening there will be a banquet, at which Secretary Wallace, Dr. John H. Finley, associate editor, *New York Times*, and Lithgow Osborne, commissioner of conservation, New York State, have been invited to speak. Henry Solon Graves, president of the association and dean of the Yale Forest School, will serve as toastmaster.

The automobile field trips on Friday, September 13, will include such outstanding examples in conservation as the Clifford R. Pettis Memorial Forest, the Lake Clear Forest Nurseries and Fish Hatchery, and the Fish Creek public camp grounds. At Wilmington Notch, Governor Herbert H. Lehman, of New York, will unveil a tablet to commemorate fifty years of conservation in the state. The evening program will be a campfire dinner and an address by J. N. Darling, chief of the Bureau of Biological Survey.

On Saturday, September 14, the new highway to the summit of White Face Mountain will be opened and the pageant in the Arena at Lake Placid will take place. President Roosevelt has been invited to take part in both events. If the President attends, there will be a conservation luncheon in the Arena.

Lake Placid lies in the heart of the Adirondack Mountains, 2,000 feet above sea level. It is easily accessible by a single day's travel by rail or motor from any point in New England, New York, New Jersey and Pennsylvania. Special summer excursion rates are available. By airplane, it is within two and one-half hours from New York City.

RECENT DEATHS AND MEMORIALS

DR. CURTIS F. MARBUT, chief of the Soil Survey of the Department of Agriculture and honorary professor of geology at the University of Missouri, died on August 25 at the age of seventy-two years, from pneumonia after a railroad trip from England by way of Moscow. He was *en route* to Peiping to undertake a study of Chinese soils at the request of the Chinese Government. Dr. Marbut sailed from Baltimore on July 17 to attend a meeting of the International Conference of Soil Science in Oxford, England, before proceeding to China. Having received six months' leave of absence, he intended to return through India to Italy and carry on some research work in Rome before coming back to this country. He would have retired from the government service on July 1, 1936.

DR. EDWIN RAYMOND LECOUNT, professor of pathology and chairman of the department at Rush Medical College, Chicago, died on August 23 at the age of sixty-seven years.

THOMAS A. EDISON, JR., son of the late Thomas Alva Edison, in charge of the research engineering department of Thomas A. Edison, Inc., known especially for improvements made in combustion engines, died on August 25. He was fifty-nine years old.

DR. ANNA MARIA RHODA ERDMANN, professor of general biology at the University of Berlin, known for her work in experimental cytology, died on August 25 at the age of sixty-five years. After four years' association with the Robert Koch Institute of Berlin, Professor Erdmann came to the United States in 1912 and lectured at Yale University Graduate School, becoming later an associate of the Rockefeller Institute for Medical Research. After her return to Berlin in 1919, she became a professor at the University of Berlin.

THE death is announced of Dr. Max Cremer, emeritus professor of physiology in the University of Berlin and formerly head of the Physiological Institute of the Veterinary College, Berlin.

A MEMORIAL to Simon Newcomb will be unveiled this summer in the village of Wallace, Nova Scotia, where he was born a hundred years ago.

THERE is in process of preparation a memorial volume to the late Dr. G. Carl Huber, who, until his death last December, was dean of the Graduate School and head of the department of anatomy of the University of Michigan. It will contain seven doctorate theses worked out largely under Dr. Huber's direction, and several short articles by former colleagues dealing with different phases of his life. It is to be published as a subsidized extra volume of the *Journal of Comparative Neurology*.

A PORTRAIT of the late Dr. William B. Rogers, at one time dean and professor at the University of Tennessee College of Medicine, was recently presented to the college by former students and by the faculty of the old college. The presentation was made by Dr. Joseph A. Crisler, Sr., at a meeting of the Memphis and Shelby County Medical Society and was accepted by Dr. James B. McElroy, professor of medicine.

SCIENTIFIC NOTES AND NEWS

DR. F. L. RANSOME, since 1927 professor of economic geology at the California Institute of Technology, previously from 1897 to 1924 assistant geologist and geologist to the U. S. Geological Survey, later professor of economic geology and dean of the Graduate College of the University of Arizona, has been elected an honorary member of the Geological Society of Belgium.

HONORARY fellowship of the Royal College of Surgeons, London, will be conferred on October 10 on Dr. William B. Coley, professor of clinical cancer research at Cornell University Medical College. He will at that time deliver a lecture on "The Treatment of Inoperable Malignant Tumors with the Toxins of Erysipelas and Bacillus Prodigiosus," based on a study of end-results from 1893 to 1935.

DR. HOWARD DITTRICK, Cleveland, has been named an official delegate from the United States to the tenth International Congress of the History of Medicine, which will be held in Madrid from September 23 to 29.

THE gold medal of the Royal Agricultural Society will be conferred this year on Lord Ernle. The medal is given in recognition of services rendered to the agricultural industry generally. Sir Merrik Burrell, who is chairman of the veterinary and research committees of the society, has been nominated for the presidency.

THE *Journal* of the American Medical Association states that the Sternberg Memorial Medal has been awarded by the executive faculty of the University of Michigan Medical School to William George Gordon; this is an annual prize given to the medical student who has the best record in preventive medicine. The Wee Kim Lim scholastic key was awarded to student Robert Toru Masuhara for his work in roentgenology. This key was established by the Michigan Alpha chapter of Alpha Lambda, the international Chinese fraternity, to be presented to a distinguished senior medical student each year.

AT a recent meeting of the board of regents in Los Angeles, the term of Dr. Langley Porter as dean of the University of California Medical School, San Francisco, was continued one year. Dr. Porter's normal retirement period was reached this year. He has been dean of the medical school since 1927.

DR. RUDOLPH MATAS has resigned as chief of the department of surgery at Touro Infirmary, New Orleans, and Dr. Isidore Cohn has been appointed to succeed him. It was stated that Dr. Matas wished "to free himself of administrative and teaching duties so that he would have more time to devote to strictly professional activities." Following his resignation, Dr. Matas was named honorary chief of the surgical service. He is now seventy-four years old.

JOHN M. WESTGATE, director of the Hawaii Station since 1915, has resigned to become professor of tropical agriculture in the University of Hawaii. He leaves for the Oriental tropics in September to make studies relating to tropical crops. He is succeeded by Dr. O. C. Magistad, formerly chemist for the Pineapple Experiment Station, Honolulu. Dr. G. V. Parris, who obtained his doctorate at Cornell University in June, 1935, will become plant pathologist for the Hawaii Station on September 1. William Storey, formerly student assistant, has been appointed assistant in horticulture. He was recently awarded a university fellowship and will pursue graduate studies in the field of genetics.

ROBERT L. PENDLETON, for nearly twelve years professor of soil technology and for the past five years in addition head of the Department of Soils, College of Agriculture, of the University of the Philippines, at Los Banos, has retired to accept a position as soil technologist and agriculturist to the Department of Agriculture of the Siamese Government. His headquarters will be in Bangkok, Siam.

Industrial and Engineering Chemistry reports that Dr. Felix Singer has been retained as consulting ceramic engineer by The United States Stoneware Company, New York, N. Y. In 1933 Dr. Singer was obliged to resign his connection with the Deutsche Ton- und Steinzeug-Werke and to leave Germany for England, where he now resides.

THE New Hampshire Forestry Commission announces the appointment of two research fellows under the Fox Trust Fund for Forest Research for the period of one year from June 1, 1935. The fellowships carry a base stipend of $150.00 and require a minimum of two months' residence. A. Heaton Underhill, Dartmouth, 1936, will study the relation of forest and soil types to conditions for fish life in streams and ponds. He will work especially on the Pillsbury State Forest. Miss Helen E. Hazard, Cornell, 1935, will investigate the relation of floristic composition of forest types to site quality in southern New Hampshire. The investigations will be carried out under the Caroline A. Fox Research and Demonstration Forest at Hillsboro, N. H.

Nature states that the managers of the Royal Institution, London, have awarded the Dewar research fellowship to A. R. Ubbelohde, formerly senior scholar of

Christ Church, Oxford, and at present holder of a senior research award of the Department of Scientific and Industrial Research. Mr. Ubbelohde's researches have been largely in physical chemistry, and it is expected that his experience will be valuable in connection with the researches directed by Sir William Bragg on the structure of matter.

CURTIS P. CLAUSEN, in charge of foreign parasite introduction for the U. S. Department of Agriculture, and H. L. Parker, head of the Bureau of Entomology and Plant Quarantine Laboratory at Hyères, France, will represent the department at the sixth International Congress on Entomology, in Madrid, from September 6 to 12. Mr. Clausen sailed from New York on August 20.

DR. W. R. GREGG, chief of the Weather Bureau, sailed on August 14 for England, *en route* to the Continent, where he will attend international meetings of meteorologists. He was accompanied by J. B. Kincer, chief of the Climate and Crop Weather Division of the bureau. After conferring with British and French meteorologists they will attend the triennial meetings of the International Climatological Committee and the International Committee of Agricultural Meteorology in Danzig the last of August and the first of September. They will then go on to Warsaw for a meeting of the International Meteorological Committee. Mr. Gregg will attend the general session of the international meeting of meteorological directors in Warsaw, from September 5 to 13. Mr. Kincer will spend this time conferring with officials of the meteorological services of Denmark, Sweden and Norway. Both will confer with the meteorological officials of USSR in Moscow and of Germany in Berlin, with a view to working out better methods for exchanging weather observations used in preparing the daily forecasts on both sides of the Atlantic. The trip will end with a visit to the Deutsche Seewarte in Hamburg.

DR. H. A. GLEASON, head curator at the New York Botanical Garden, recently elected deputy director of the garden, is spending two months at the Biological Station of the University of Michigan, on the shores of Douglas Lake.

THE Royal College of Physicians, London, has appointed lecturers as follows: Sir Walter Langdon-Brown, Harveian orator, 1936 (the forthcoming Harveian Oration in October next will be delivered by Sir Henry Dale); Dr. Edward Mapother, Bradshaw lecturer, 1936; Dr. E. L. Middleton, Milroy lecturer, 1936; Dr. R. A. McCance, Goulstonian lecturer, 1936; Dr. John Parkinson, Lumleian lecturer, 1936; Dr. Joseph Needham, Oliver-Sharpey lecturer, 1936; Dr. J. D. Rolleston, FitzPatrick lecturer, 1936; Dr. R. R. Traill, Mitchell lecturer, 1936, and Dr. Edwin Bramwell, Croonian lecturer, 1937.

DR. HENRI COUTARD, chief of the department of the roentgentherapy of cancer at the Curie Institute, University of Paris, France, will deliver the twelfth Lewis Linn McArthur lecture of the Frank Billings Foundation of the Institute of Medicine of Chicago, on October 1. The subject of the lecture will be "The Conception of Periodicity as a Possible Directing Factor in the Roentgentherapy of Cancer."

DR. FRANK C. WHITMORE, dean of the School of Chemistry and Physics at the Pennsylvania State College, during the period from October 14 to 31 will speak before various Southern Sections of the American Chemical Society on "Some Simple Aliphatic Chemistry." He will discuss the simpler normal and abnormal reactions of organic chemistry from the point of view of the general chemist rather than that of the specialist, speaking at the following places: Richmond and Lynchburg, Virginia; Kingsport and Knoxville, Tennessee; Gainesville, Florida; New Orleans; Tuscaloosa, Alabama; Athens, Georgia; Greenville, South Carolina; Atlanta, Georgia; Birmingham, Alabama; Nashville, Tennessee; Lexington, Kentucky, and Charleston, West Virginia. From October 31 to November 2, he will be at the Mid-west Regional Meeting of the American Chemical Society at Louisville, Ky., where he will present a paper on molecular rearrangements.

THE American Chemical Society meeting in San Francisco, under the presidency of Professor Roger Adams, has adjourned to meet in Kansas City in the spring of 1936. The following meeting will be held in the autumn at Pittsburgh, Pa. The spring and fall meetings of 1937 will be held in Chapel Hill, N. C., and Rochester, N. Y., respectively.

THE fifth convention of the Biological Photographic Association will be held at the Stevens Hotel, Chicago, on September 12.

THE ninth annual conference of the Western Section of the International Crop Improvement Association was held this year at the Wisconsin College of Agriculture on July 26 and 27. About seventy-five alfalfa seed producers, distributers and consumers attended with the purpose of discussing the intricate problems of the alfalfa seed industry.

THE sixth Floating Congress of the Pan American Medical Association, en route to New York City from its cruise to Rio de Janeiro, Brazil, stopped off at San Juan, Puerto Rico, on July 29. The School of Tropical Medicine contributed as its share in the entertain-

ment program for the congress a series of exhibits of the various phases of tropical diseases, on which the faculty of the school has been working. All departments were represented. After viewing these exhibits, the visitors attended a symposium on tuberculosis held under the auspices of the Insular Department of Health.

AT the time of the International Neurological Congress in London, a meeting of those particularly interested in epilepsy was held on July 31 at the Lingfield colony. Thirty-two doctors, representing fourteen countries, were present. After discussion, it was unanimously decided that the International League against Epilepsy should be revived. The immediate efforts should be directed toward the improvement of the social condition and the institutional care of persons with epilepsy. To this end, it was agreed that there should be a publication, issued annually or oftener, acquainting readers with facilities and with remedial efforts carried on in various countries. Plans were also laid for a meeting of the league at the time of the next Neurological Congress in Copenhagen. At an adjourned meeting held on August 2 (Professor A. Ley, of Brussels, in the chair) the following officers were elected: *President,* William G. Lennox, Boston, Mass., U. S. A.; *Secretaries,* H. I. Schou, Filadelfia, Denmark; L. J. J. Muskens, Amsterdam, Holland; *Treasurer,* J. Tylor Fox, Lingfield, Surrey, England. All persons interested in improving the condition of epileptics are invited to join the league.

THE members of the third International Congress of Soil Science took part in a post-congress tour of Britain, making a three-day visit to Aberdeen. They made a tour of the experimental farm of the North of Scotland College of Agriculture at Craibstone, the Rowett Research Institute, the Duthie Experimental Stock Farm, and the Macaulay Institute of Soil Research. They were received at Craibstone by Professor J. Hendrick, of Aberdeen University, and were shown the drain gauges, soil profiles and various experiments in the woodland fields. At the experimental farm W. Godden and A. Crighton explained the work carried out by the institute. In the evening the delegates were given a civic reception at Aberdeen Art Gallery.

THE General Education Board recently made a gift of $2,500,000 to Vanderbilt University for the School of Medicine. About $700,000 will be used for buildings and equipment and the remainder for an endowment.

DR. GODFREY LOWELL CABOT, of Boston, a trustee of Norwich University at Northfield, Vt., has given to the university in memory of his son, who died in the war, a "substantial" sum to found "the James Jackson Cabot professorship of air traffic, regulation and transportation," in the hope that it will promote the formulation of an international air safety code in which the United States might lead the way.

F. D. RICHEY, chief of the U. S. Bureau of Plant Industry, writes: "A letter from Dr. F. J. F. Shaw, director of the Imperial Institute of Agricultural Research, Delhi, India, under date of July 25, notes that 'the Pusa Institute was wrecked in the great Bihar earthquake of the thirteenth of January, 1934. The Government of India in consequence of this decided to move the entire Research Institute to a site near Delhi where new laboratories are now in process of erection and the farm is being laid out. For this reason I am now stationed in Delhi as the work of design and layout falls upon me and the Botanical Section at Pusa is for the present in charge of Dr. Pal. I am glad to say that we had no loss of life and that the actual Botanical Section Laboratory did not sustain serious damage. I am sending you this information so that our correspondents abroad should realize that the Delhi Institute is the same as the Pusa Institute. I expect to complete the transfer of all the staff and equipment to the new site about October, 1936.'"

A SPECIAL frost forecasting service for Florida, lasting from the middle of November till April, has been provided by the U. S. Weather Bureau. The service, made possible by a $15,000 federal and a $10,000 state appropriation, will be similar to the services already set up in California, Washington, Oregon, Texas and southern Alabama. Headquarters have not been selected. E. S. Ellison—trained in frost forecasting in California—will have charge of the work. Five others will forecast each day minimum temperatures for the following night in the sections assigned to them. These forecasts—based on the regular weather maps and on special temperature, moisture and air mass observations made with equipment installed for the purpose throughout the state—will be published by the press and broadcast. Besides warning growers of dangerous crop weather, thermometers and equipment used in heating orchards will be checked.

DISCUSSION

ON THE FORMATION OF LAKE BALLS

BALLS of vegetable or animal matter are at times found on the shores of lakes or of the sea, but only in a few widely scattered localities. They have been variously named (see Ganong[1, 2] and Schröder[3]) and

[1] *Rhodora,* 7: 41, 1905.

vary considerably in composition. The *Cladophora* balls (see Kindle[4] for description and figures) result from the radial growth of this Alga. Schröder gives quite a number of cases of both plants and animals (*e.g.*, sponges) which may take a spherical shape in their growth when free from the bottom and kept rotating by water oscillations. In 1923 the Biological Board boat *E. E. Prince* obtained at a few fathoms depth in an arm of the Bay of Exploits, in northeastern Newfoundland, roundish masses of the calcareous alga, *Lithothamnium*, as much as six inches in diameter and three inches deep. They were hollow and usually there was an opening through to the central cavity, which had evidently been formed by the disintegration of the oldest part of the plant, the shell that remained and continued growing on the outside being for the most part less than half an inch thick. These masses had been resting loosely on the bottom on one of the flattish sides.

Many of the balls that are found on shores are not living growths, but are composed of varied debris. These seem to have been universally attributed to their constituent parts becoming matted together under the action of waves in shallow water. If built up in this fashion, they would tend to have, not a radial structure, but an interlacing or felted structure with more or less distinct concentric lamination. Perhaps the best instances of this type are the balls found on certain shores of the Mediterranean, the essential parts consisting of thread-like fragments of the rhizomes of *Posidonia*, as described by Russell.[5]

While some of the balls formed of debris may have had such an origin there are those that must be explained otherwise. They show no concentric lamination, and the materials of which they are composed tend to separate under wave action on a beach. I have been able to examine a number of balls, obtained in 1919 at Little Kedron Lake, New Brunswick, by Dr. H. S. Everett. He obtained others in 1931, and Ganong[6] obtained and described one from this same lake in 1904. They are not found elsewhere in the many lakes of the region so far as known, and they are found only in one bay of this lake. They are locally known as "spill balls," as they are largely made up of the "spills" or needles of fir and spruce. While some were almost perfect spheres, others were somewhat irregular, though well rounded. When sawn through there was no evidence of concentric, but some of transverse, lamination. The surface was evidently being worn away by rolling on the bottom, and the spherical shape seemed, therefore, to have been produced in the same way as the rounding of stones on an exposed beach. Ganong appears to have had only one dried specimen and, believing that it had been put together by wave action, comments: (1) "It is very remarkable that such smooth objects (the needles) can thus cling together, but still more remarkable that they should become interlocked in the first place." One of the balls, on being dried, promptly went to pieces, showing how insecurely the needles were interlocked. It may be safely surmised that the needles settled into some relatively deep and quiet water, forming in the course of time a thick dense mat, which would be broken into pieces by an exceptional storm and the pieces rounded on the beach by wave action. The combination of conditions which would make this possible is sufficiently unusual to account for the rarity of these "spill balls." It seems probable that the balls of fir needles mentioned by Russell[7] as being in the Zurich Museum and coming from lakes of the Engadine were formed in similar fashion, as also the "sea-balls" from the coast of Nova Scotia figured by MacKay.[8] As this method of the formation of lake balls seems not to have been hitherto recognized, it seems worth while to present the case for it.

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THE SOLDADO ROCK SECTION

IT is to be regretted that Dr. H. W. Shimer's recent correlation[1] is marred by a serious error on plate 122 where the Soldado Formation is referred to the Upper Eocene and placed as equivalent to the St. Bartholomew limestone, the type of the Upper Eocene of the Antilles. In truth the Soldado Formation is the type of the Lower Eocene of the Antillean and northern South American areas.

The faunas of Soldado Rock, Gulf of Paria, were described and figured by me in 1912,[2] bed No. 2 being correlated as basal Eocene. Later I extended this horizon to Margarita and Toas Islands, Venezuela.[3] In SCIENCE, 1925, I named this No. 2 bed the Soldado Formation,[4] "to stand as the type of northern South American and of Antillean basal Eocene deposits."

In 1928, Mr. Liddle gave the name Soldado Formation,[5] *as new*, to a very different geological formation

[2] *Rhodora*, 11: 149, 1909.
[3] *Die Naturwissenschaften*, 8: 799, 1920.
[4] *Amer. Midl. Nat.*, 15: 752, 1934.
[5] *Rev. gen. de bot.*, 5: 65, 1893.
[6] *Bull. Nat. Hist. Soc. N.B.*, 23: 304, 1905.
[7] *Loc. cit.*
[8] *Proc. Trans. N.S. Inst. Sci.*, 11: 667, 1908.
[1] Hervey W. Shimer, *Bull. Geol. Soc. America*, 45: 909-936, Pls. 118–122, 1934.
[2] Carlotta J. Maury, *Jour. Acad. Nat. Sci. Philadelphia*, second series, XV: 23–112, Pls. 5–13, 1912.
[3] C. J. Maury, *American Jour. Science*, fifth ser., IX: 53, 412, 1925.
[4] C. J. Maury, SCIENCE, LXI: 1567, 43, January, 1925.
[5] R. A. Liddle, "Geology of Venezuela and Trinidad," p. 225 and elsewhere, 1928.

referred by him to the Upper Eocene. Dr. Shimer has followed this invalid usage. In citations from my 1912 memoir, Mr. Liddle actually mixed together my faunal lists, and inverted my foraminiferal bed (No. 6) and my upper molluscan bed (No. 8), and pronounced the results confused!

Thereupon, I published in 1929 a complete history of the Soldado Rock Section,[6] again defining the Soldado Formation as Lower Eocene. Furthermore, I gave the name Boca de Serpiente Formation to my upper molluscan bed (No. 8), correlating it as Uppermost Eocene, equivalent to the European Ludian; while the foraminiferal bed (No. 6) was placed in the Bartonian. All due credits and citations were given.

Soldado Rock is of extreme paleontologic and stratigraphic interest. The Soldado Formation (bed No. 2) has a fauna linked by allied forms to the Lower Eocene of Alabama and to that of Pernambuco, Brazil, as shown by the writer in 1912. It also contains a remarkable genus, *Veatchia* Maury, with the genotype and only known species, *Veatchia carolinae* Maury, which in 1926 was traced from the rock to the mainland of Trinidad by Waring and Harris, in the Marac quarry,[7] in the southern part of the island, and referred by them to the basal Eocene.

In conclusion, the Soldado Rock section is the key to the interpretation of the Antillean and northern South American Eocene. The lower molluscan bed (No. 2) the Soldado Formation Maury, 1925, represents the first discovery of Old Eocene in the entire Antillean area. The foraminiferal bed (No. 6) is Bartonian, and goes with the foraminiferal marls of Bontour Point, Trinidad, referred by Douvillé,[8] in 1924, to the Bartonian. My upper molluscan bed (No. 8) is Ludian. This marked the first recognition of both Bartonian and Ludian deposits as separate entities, in the entire Western Hemisphere.[9] As I noted in 1931, this South American Bartonian can be traced from Soldado Rock and Trinidad to Panama, Ecuador and Peru, and is comparable in age and faunal affinities with the Upper Mokattam of Egypt. The St. Bartholomew limestone, long the type of Antillean Upper Eocene, goes with this Bartonian horizon. In Colombia, I regard a horizon west of El Carmen as Ludian and equivalent stratigraphically to my Boca de Serpiente formation (bed No. 8) of Soldado Rock. This ties up with the Saman formation of Peru. The main fossiliferous beds of the 1912 Soldado section are thus traced across the entire northern South American mainland.

CARLOTTA JOAQUINA MAURY

YONKERS, N. Y.

[6] C. J. Maury, *Journal of Geology*, XXXVII: 2, 177–181, February–March, 1929.

[7] G. A. Waring and G. D. Harris, The Johns Hopkins University Studies in Geology, No. 7, pp. 99, 101, 1926.

[8] Douvillé, Memoires Société geol. de France, p. 19, 1924. See also Illing, *Quarterly Jour. Geol. Soc. London*, 84, pt. 1: 7, 1928.

[9] C. J. Maury, *American Jour. Science*, XXII: 375–376, October, 1931.

UNISEXUAL LIMBER PINES

IN the course of an investigation on alpine vegetation in the Rocky Mountain National Park in Colorado in the summer of 1932, the writer found at timberline individuals of limber pine (*Pinus flexilis* James) that differed in appearance so markedly from the usual form as to suggest an unknown species. Close scrutiny, however, revealed that the characteristics of the aberrant form intergraded with the normal except in two ways: (1) All the leaves on a tree were uniformly shorter in length and closer spaced on the twig, and (2) the individual trees produced only male cones. Inasmuch as many of the typical trees produced but very few or no male cones, there is apparent a tendency of the species to separate the sexes to different individuals, a deviation from the normal, which is to have both sexes on the same tree. From the Alps of Switzerland a similar tendency has been reported of the five-leaved mountain pine (*Pinus montana* Miller).[1] In spite of much search in the region, and over the whole altitudinal range of the species, this phenomenon was found to exist only at timberline. Because of its many important implications, it would seem very desirable to know more about the areal and altitudinal extent of the occurrence of this tendency. It is hoped that other observers will communicate their observations.

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AN APPEAL TO SCIENTISTS OF THE USSR

A RECENT study of the extinct elasmotherine rhinoceroses necessitated assimilation of the literature, in large part by Russian vertebrate paleontologists. During the eighteenth and nineteenth centuries such Russian works were almost invariably published in French, German or Latin and, therefore, were readily available to non-Russian workers. During the present century, a constantly increasing proportion of the valuable Russian work in vertebrate paleontology has been published in the Russian language. Such papers may be entirely in Russian, may append a translated title, usually in the table of contents, or they may add a short résumé, of a paragraph or so, in English, German or French. Any one of these procedures makes the paper virtually unavailable to non-Russians, except for such inferences as may be based on the illustrations. On the other hand, another author, or the same author on another occasion, may append a full résumé, covering all essential facts and generalizations, or he may publish a briefer version, in one of

[1] C. Schroeter, "Das Pflanzenleben der Alpen," 1926.

the western languages, as an independent paper. These last two marks of consideration would be even more useful, if, in the first case, the captions of the illustrations and of the tables of measurements were made bilingual and, in the second case, if the actual relation to the longer Russian text were explicitly stated in the concentrated paper.

The view-point of those who publish in Russian only, or with a tantalizingly brief and often non-committal abstract, seems fair enough in strict equity alone. Russian scientists must be able to read English, French and German, in order to utilize the foreign literature: why, then, should not the foreign worker learn Russian, in addition to the other two languages, beside his own? One might, perhaps, legitimately doubt, on the basis of the objective evidence, what percentage of the younger Russian workers are actually masters of all three of the languages in question. However, since the abandonment of Latin as the scientific *lingua franca,* an overwhelming proportion of all scientific work has been published in either English, French or German. There are already clear indications that, if publication in Russian becomes much more prevalent, it will be regarded as sufficient precedent for an epidemic of scientific publication in other Slavic languages, in the Scandinavian languages and even in Chinese and Japanese. It is difficult to exaggerate the chaos that would follow. Instead of the language barrier being simplified, with the spread of scientific progress, it would be made correspondingly more impassable. Present publication of original results in Italian or Spanish presents a slightly different situation. If French or French and Latin are known, a paper in one of these languages may be guessed at; and a respectable minority of western scientists is familiar with one language or the other, so that important new material and ideas become generally available, sooner or later. It is at the choice of the authors if much merely competent work in these languages is slighted.

Our Russian colleagues may well feel that, if we continue to be ignorant of their work, the loss is ours, and that we shall, eventually, be forced to learn Russian in self-defense. The academic requirement of the two other languages than one's own of English, French and German, is so thoroughly and widely established that it is very unlikely to be altered in the near future. And there is an obvious, reciprocal loss to Russian scientists if the west remains regretfully ignorant of most of their fine work. Although this appeal for mercy applies particularly to the literature of vertebrate paleontology, a similar situation evidently exists in other fields.

HORACE ELMER WOOD, 2ND

DANA COLLEGE
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SPECIAL CORRESPONDENCE

A PERSONAL REPORT ON THE NATIONAL FORESTS

IN July and early August of this year I visited five of the ten National Forest Regions in the United States. Most of the inspecting was done by auto, but a little on horseback and some on foot. The outstanding impression in my mind was the universally fine esprit de corps. Everywhere the men think first, last and all the time about the public interest as contrasted with the regional or private interest. Again and again I asked how it happened that so many men had become filled with the necessary courage and intelligence to act for the long-time, general interest instead of the short-time local and political interest. The explanation goes back to Gifford Pinchot and Theodore Roosevelt.

Gifford Pinchot, in his missionary zeal, built an organization which stands as one of the greatest monuments to any living man. No matter how much disagreement there may be over Pinchot as a Progressive Republican political figure, there can be no disagreement over the marvelous contribution he made to the people of the United States in building the Forest Service firm and strong. Ever since Pinchot left the service in 1909, forester after forester has been firm to the faith of the first chief.

No one has ever brought to my attention the slightest suggestion that any lumber company has profited unfairly as a result of Forest Service laxity or favoritism. Steadily the 170,000,000 acres of national forest properties have been improved. Millions of trees have been set out. Logging has been allowed only on such areas, and under such conditions, as would assure an adequate and continuous timber crop. In recent years logging has not been allowed in areas of outstanding recreational or scenic values.

The whole idea has been to devote the land and all its resources to its highest public use; to fit national forest lands for such uses as their character, that of their resources and the needs of the public will permit. To do this, multiple-use is necessary. That means selective logging, which will maintain the present lumber industry and prevent ghost towns, and developing camp grounds or renting land at $15 to $25 a year for summer homes, perhaps where attractive trout streams are handy to good roads. Again it means

issuing permits to stockmen to graze the land and, as for example in the Kaibab Forest of northern Arizona, paying especial attention to maintaining wildlife. In this particular forest you may see, almost any evening on the shadowed edges of a single meadow, more than 100 deer.

The problem which aroused my interest most—because it is least solved—is the grazing problem. It is inseparably linked with forest land. Indeed, within the continental United States, about 334,000,000 acres —more than 50 per cent. of all commercial and non-commercial forest lands—are grazed by domestic live stock. And these forested grazing lands are vital to farmers and their live stock in the Central, New England, Middle Atlantic and Lake States as well as in the South and the West.

Nearly 6,170,000 sheep and 1,484,000 cattle grazed in the national forests in 1934. In 1920, 7,324,700 sheep and 2,120,000 cattle were allowed. There was some overgrazing, although not one third so bad as on other lands. From 1918 to 1933 the number of cattle and horses on national forests in eleven western states was reduced 38 per cent., and the number of sheep 28 per cent. In many areas the numbers should be still further reduced. All reductions—on and off the national forests—in those same states and years were only 16 per cent. and 7 per cent., respectively.

One who has not traveled in the West can not realize the terrible damage done by overgrazing. On the hills just east of the Salt Lake Valley in Utah, I call to mind how overgrazing of private land made it possible for heavy storms to start a mud flow, carrying to the valley below boulders weighing over 100 tons. In this flow, fertile valley soil, houses and even human beings were covered up. In other cases overgrazing has resulted in the rapid silting up of reservoirs.

When traveling through the forests I have found it as interesting to study the varieties of grasses and sustained yield of grass as varieties of pine and fir and sustained yield of timber. In much of the northern mountain area the good grasses have been replaced in considerable measure by awned brome grass (*Bromus tectorum*), niggerhead (which is a kind of brown-eyed Susan), sage and porcupine grass. Sage has some real value as sheep feed, but it is not nearly equal to the original grasses. Experimental plots indicate that moderate grazing is probably a good thing, but that excessive grazing is one of the great sins against nature.

Stockmen of the mountains are just beginning to realize the difference between the good and poor grasses. Generally they call the good grasses bunch grass. Bunch grass may mean any of several wheat grasses, the better brome grasses or fescues. Under moderate grazing these good species may replace themselves, but if the grazing is heavy they may disappear entirely. In such cases no one knows how practical it is to bring them back. In a country where it takes five acres to support a sheep or one hundred acres to support a cow there is some doubt as to how much money can be justifiably spent in reseeding unless protection of a valuable watershed is involved.

I never fully realized what a splendid job of controlled grazing the Forest Service has put in practice until I saw the terribly abused range land between Bozeman and Dillon, Montana. The forest land was apparently in position to carry safely three times as much stock as this land, although originally they were of similar character. Under the Taylor Grazing Act the Interior Department hopes to control grazing in somewhat the same way as the Forest Service has.

Grasses are just beginning to come into their own. Hitherto they have not had the same romantic appeal as trees. Actually, however, on a considerable part of the national forest land they are even more important than the trees, partly because of their grazing value but even more because they can prevent erosion, rapid runoff and silting up of reservoirs. The American people everywhere have sinned terribly against their grasses. The time has come to get "grass-minded," even as Gifford Pinchot and Theodore Roosevelt thirty years ago made the American people tree-conscious.

With all their allegiance to the long-time public interest, the Forest Service men have been amazingly tactful in dealing with the local communities. They have engaged in a long, slow program of education and as a result the local people have confidence in the Forest Service men.

False sentimentalists have occasionally objected. For example, when elk or deer multiply and overgraze, the Forest Service people are just as much concerned as when there are too many cattle or sheep on the range. I call to mind an area in the Olympic peninsula where the elk have so cleaned up the browse that they are reduced to eating hemlock bark and other strange substances, the result of which is necrotic stomatitis. Though protected from man and wild animals, the elk and deer often die from diseases incident to starvation as they overgraze the range. In all this, there is a common-sense answer which recognizes that elk and deer eat grass and browse, and there must be a balance between food and population. If there is an excess of wildlife it may be merciful to have a controlled kill of the surplus, or else again allow reduction by nature's process, through the cougar and the wolf.

The financial income of forest rangers and forest supervisors is low. Their public service to lumbermen, stockmen, game lovers and seekers of recreation in the

wild is high. I covet for these men the psychic income of intelligent, public appreciation to make up for that which they will never get in terms of money.

In the course of my trip I traveled over hundreds of miles of trails made by the CCC boys. I saw millions of young nursery trees tended by CCC boys. I talked from a region inaccessible except on horseback or on foot over a phone line put up by the CCC boys. I saw beautiful camp sites which they had fixed up with necessary facilities. Here and there I met them responding to fire drill in a regular camp or in a spike camp. As a result I gained the impression that the public for two generations to come will be reaping the reward from work done by CCC in 1933, 1934 and 1935 in the national forests of the United States.

HENRY A. WALLACE,
Secretary of Agriculture

SCIENTIFIC BOOKS

FAMILIES OF FLOWERING PLANTS

The Families of Flowering Plants. II. Monocotyledons. By J. HUTCHINSON. xiii + 243 pp. 107 figs. Macmillan and Company. London. $6.00.

THE first volume of this work, that dealing with the Dicotyledons, came out in 1926 and was reviewed in SCIENCE by the present reviewer. Sir Arthur Hill, in a rather over-enthusiastic foreword to the present volume, says that the lapse of time between the first and second volumes has been an advantage, "since it has allowed botanists time to study and digest the earlier volume and to realize that not only do they appreciate the value of his researches, but that they are also generally in agreement with his conclusions."

One wonders where and how Sir Arthur learned this. I would concede that no matter where they lead, such general surveys as the author has attempted are about the most valuable contributions that a botanist can make towards our understanding of the plant kingdom, but that Hutchinson's conclusions with regard to the Dicotyledons have been generally accepted is incomprehensible, even though they had been brought down from Mount Sinai. Botanists, and especially taxonomists, usually do not find it so easy to see the forest on account of the trees.

The present volume on the Monocotyledons seems both more easy and more difficult to evaluate than did Volume I. I find myself more inclined to agree with the author's conclusions, but I can not be sure that this is because of their soundness or due to my own relative ignorance. At any rate, comparisons with the schemes of Bentham and Hooker, Engler and Prantl, Hallier, Lotsy or others are overwhelmingly in favor of Hutchinson.

The general plan of the present volume consists of an introduction, all too brief, followed by an outline of the sequence of families with brief notes on general tendencies. All this takes but 25 pages. The bulk of the work, pp. 26–229, is given over to a systematic description of the orders and families, under which are given keys to all the genera except those of the Gramineae and Orchidaceae. Thus we have in one small book all the genera to date, which in itself is exceedingly useful, particularly since botanical exploration has been so active in recent years. The book concludes with a short glossary and a complete index.

The author's conclusions may be stated as follows, largely in his own words: The Monocotys are regarded as monophyletic and as showing a close resemblance to the Dicotys at but one point, that between the Butomales-Alismatales and the Ranales. Hence the last order is considered as the stock which gave rise to the Monocotyledonous evolution, with the two orders mentioned as the most primitive. Such resemblances between members of the two classes as that of the Arales to the Piperales, the Menispermaceae to the Dioscoreaceae, etc., are regarded as homoplastic and not genetic.

The hypothetically most ancient known Monocot had an apocarpous gynoecium, a biseriate perianth of sepals (often green) and petals (often white), and the rootstock was a rhizome. This group, termed the Calyciferae or calyx-bearers, is made to include 12 orders, and reaches its zenith in the Zingiberales. A line of reduction among the Calyciferae leads to the almost wholly aquatic groups, Juncaginales and Aponogetonales, climaxing in the Najales.

Somewhere among the Calyciferae (Commelinales or Butomales) there was evolved a more terrestrial race—the Liliales—and these are considered the source of the remaining 16 orders. Their chief features are the development of the corm or bulb, and an attractive uniseriate perianth. This group is termed the Corolliferae or corolla-bearers because of the resemblance of the combined whorls of the perianth to the corolla of the Dicotys. The Corolliferae are considered to comprise six lines of descent which originated among the Liliales. These are: (1) Haemodorales-Burmanniales-Orchidales; (2) Agavales-Palmales-Pandanales-Cyclanthales; (3) Arales; (4) Typhales; (5) Dioscoreales-Alstroemeriales-Amaryllidales-Iridales; (6) Juncales-Graminales-Cyperales.

As among the Dicotys, or, for that matter, among

all organisms, plant or animal, the direction of evolution, *i.e.*, whether from simple to complex or from complex to simple, haunts us. Hutchinson is a believer in the hypothetical views of the origin of the higher plants which was put forward by Arber and Parkin some years ago, which hypothesis would derive the flowering plants from the complex Mesozoic cycadophytes, hence simplification of floral parts (reduction) always characterizes derivative groups and complexity of floral organization characterizes primitive groups.

As a general principle this may well be doubted, and it certainly loses much of its cogency when other than floral structures are considered. But taxonomists started with flowers and the millennium will doubtless be in the offing before they can make intelligent use of the rest of the plant. I would not wish to imply that reduction is not often the mode of evolution, *e.g.*, Hutchinson is obviously right in considering Najas reduced and not primitive, as it has frequently been considered.

Hutchinson has found it necessary to reshuffle the Liliaceae and Amaryllidaceae, and this I can not commend too highly. The old criterion between the two families—superior ovary in the former and inferior ovary in the latter, is boldly discarded. His criterion is largely the type of the inflorescence. Thus the Amaryllidaceae get the tribes Agapantheae, Allieae and Gilliesieae; the tribes Trilliaceae, Smilacaceae, Ruscaceae, Xanthorrhoeaceae, Alstroemeriaceae, Velloziaceae, Hypoxidaceae and Agavaceae are given family rank, as indeed many of them have in previous taxonomic schemes. There is also considerable shifting of genera back and forth.

The actual geological history of the Monocotys is for the most part unknown. Certainly too little is known to afford any check on the conclusions of the present work. Pondweeds, palms, grasses and sedges are already present in the Mid-Cretaceous, so that if evolution has proceeded, as outlined by Hutchinson, we are obliged to visualize an unsuspected antiquity for the lilies and buttercups.

I could wish that the climatic regions were more sharply drawn, *e.g.*, Tillandsia is hardly confined to the tropics and subtropics, and some of the most striking genera of the Bromeliaceae occur in the temperate altitudinal zone in the Andes. More of the excellent distributional maps would have added to the text, and there are minor points that might be criticized; thus I can not conceive southwest Australia as the original home of anything primitive, *cf.* Anarthria of the Restionaceae.

The book represents a tremendous amount of intelligent work and I find it extremely stimulating and very useful. I do not see how any botanist, except the most narrow, can but derive a great deal of pleasure and profit from it. I hope that it will be provocative of much more discussion than I believe it will, human beings being what they are. The author is to be congratulated in having formulated a much more consistent and better scheme for the Monocotyledons than that of any of his predecessors, in spite of what the ultimate fate of his views may be.

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METEOROLOGY

Physical and Dynamical Meteorology. By DAVID BRUNT. xxii + 411 pages, with 112 figures. Cambridge, England: At the University Press. New York: The Macmillan Company, 1934. $7.00.

SOME twenty-two centuries ago meteorology already was accounted an important science; so important indeed that the discriminating Aristotle wrote a sizable and excellent book on it. Then for two millennia the rains came and the winds blew with never an explanation of how or why—curiosity was inhibited by faith and inquiry estopped by authority. Slowly came a drowsy awakening, with a few observations and the foreshadowing now and then of some meteorological fact; and in the midst of this awakening a galvanic shock to alertness by the invention of the telegraph, by means of which a vessel, a fleet or a community could be warned of a coming storm many hours before its arrival. Finally, at the beginning of this century, all the world became air- and weather-conscious, since when the science of meteorology has been going faster and faster on the wings of the flying machine.

Not long ago meteorology was a descriptive subject that required no preparation to study and but a few weeks' time to master, whereas to-day it ranges nearly the whole field of classical physics with all the mathematics that implies. The now formidable state of this science is convincingly illustrated by the book under review, though it ranges but half the field implied by its title, omitting atmospheric electricity and meteorological acoustics. Applied meteorology of every kind and climatology also are omitted, and indeed are no proper parts of the subjects under discussion.

After a brief account of descriptive meteorology, as a background of facts, the author develops neatly, and with many equations, the thermodynamics of both dry and humid air, including, of course, the necessarily tedious discussion of the temperature and pressure changes in a rising mass of air through its dry (precondensation) stage, rain stage and snow stage. Entropy is illuminatingly discussed and wet-bulb temperatures shown to be full of valuable information when treated with proper mathematical respect.

The next topic is of the utmost importance, exceed-

ingly difficult and, as yet, but imperfectly understood, namely, radiation, both solar and terrestrial, and absorption, including their various effects on the atmosphere. Here the author is dealing with one of his favorite subjects and the result is correspondingly excellent, even though his widely distributed castigations may seem a trifle severe. Then the subject changes to a discussion of the motions, both horizontal and vertical, of a compressible fluid over a rotating sphere and the interactions of passing discrete currents of this fluid upon each other. These problems give pause to the beginner, but they have the advantage of being more fully solved than almost any others in the whole field of meteorology.

Following this are 61 pages on atmospheric turbulence and associated problems, pages which fortunately, and despite their importance, not many practical meteorologists have to master before entering upon their work. Sixteen pages of mathematical reasoning are given to the transformations of energy in the atmosphere. After this the problems of the genesis and maintenance of the cyclone and anticyclone are discussed. This leads quickly to a consideration of discrete air masses and their fronts, in which all that has been done in "air mass analysis" is given a friendly but unstampeded judgment.

The last chapter discusses with equal frankness the general circulation of the atmosphere, about which, physical geographies and elementary works on meteorology to the contrary notwithstanding, astonishingly little is really known.

A few brief but useful tables make up an appendix, and there is a good index. But what of the errors? There aren't any, worth mentioning.

Many a meteorologist will find this book hard reading, but it is so valuable that he should keep it, like Shakespeare and the Bible, close at hand for appearance's sake, at least.

W. J. HUMPHREYS

U. S. WEATHER BUREAU

SPECIAL ARTICLES

FURTHER OBSERVATIONS ON THE POTENTIAL RHYTHMS OF THE CEREBRAL CORTEX DURING SLEEP

IN a previous communication[1] we have reported certain observations made on human subjects whose brain rhythms have been recorded as they appeared between two electrodes placed on the forehead and crown of head. The record of each subject was usually of seven hours' duration, starting as the subject retired. Customarily the subject's pulse rate, respiration rate and any movements made during the night were also recorded. The outstanding discovery was that trains of regular waves of a particular character could be produced when certain sounds were made while the subject was asleep. The same sounds produced no waves when the subject was awake.

Since the previous communication the installation has been extended so that the rhythms from two parts of the head could be recorded simultaneously by means of two matched amplifiers and recorders. These were checked, prior to each run, against sinusoidal potentials of known frequency and voltage. The three electrodes were placed on the midline: one on the high forehead, the second on the crown and the third on the occiput. The region between the first and second electrodes will be referred to as the "front area" and that between the second and third electrodes as the "back area." Eleven persons ranging in age from 5 to 48 years have been investigated either during an all-night sleep or an after-lunch nap.

[1] SCIENCE, 81: 597, 1935.

We have distinguished at least four characteristic types of waves which have appeared in both areas. Fig. 1 shows typical examples, which we have named for convenience of description (E) spindles, (D) trains, (C) saw-tooth, (B) random.

When an adult subject first retired for the night, "trains" appeared in both areas in great number. These continued after the subject had fallen asleep for some time, gradually becoming less numerous, shorter and of lower amplitude, finally changing to the "random" type. This change is illustrated in Fig. 1-A. If the subject awakened during the night the "trains" usually appeared at once and then changed gradually to the random type as he sank into deep sleep again. The impression was gained that a change in the level of consciousness was connected with this change in type of wave. Children and young persons in very deep sleep showed the random type predominantly with only occasional trains or spindles. A sudden change from the random type to trains could be caused by speaking to a drowsing subject. In every case observed both areas have changed in the general type of wave simultaneously.

On the other hand, when trains and spindles were appearing in both areas, the individual trains and spindles usually showed no correspondence in time of appearance. They might appear in the front area with none in the back, and *vice versa,* or they might appear simultaneously in both but last for a shorter time in one, or their frequency might be different. All possible degrees of correspondence as regards

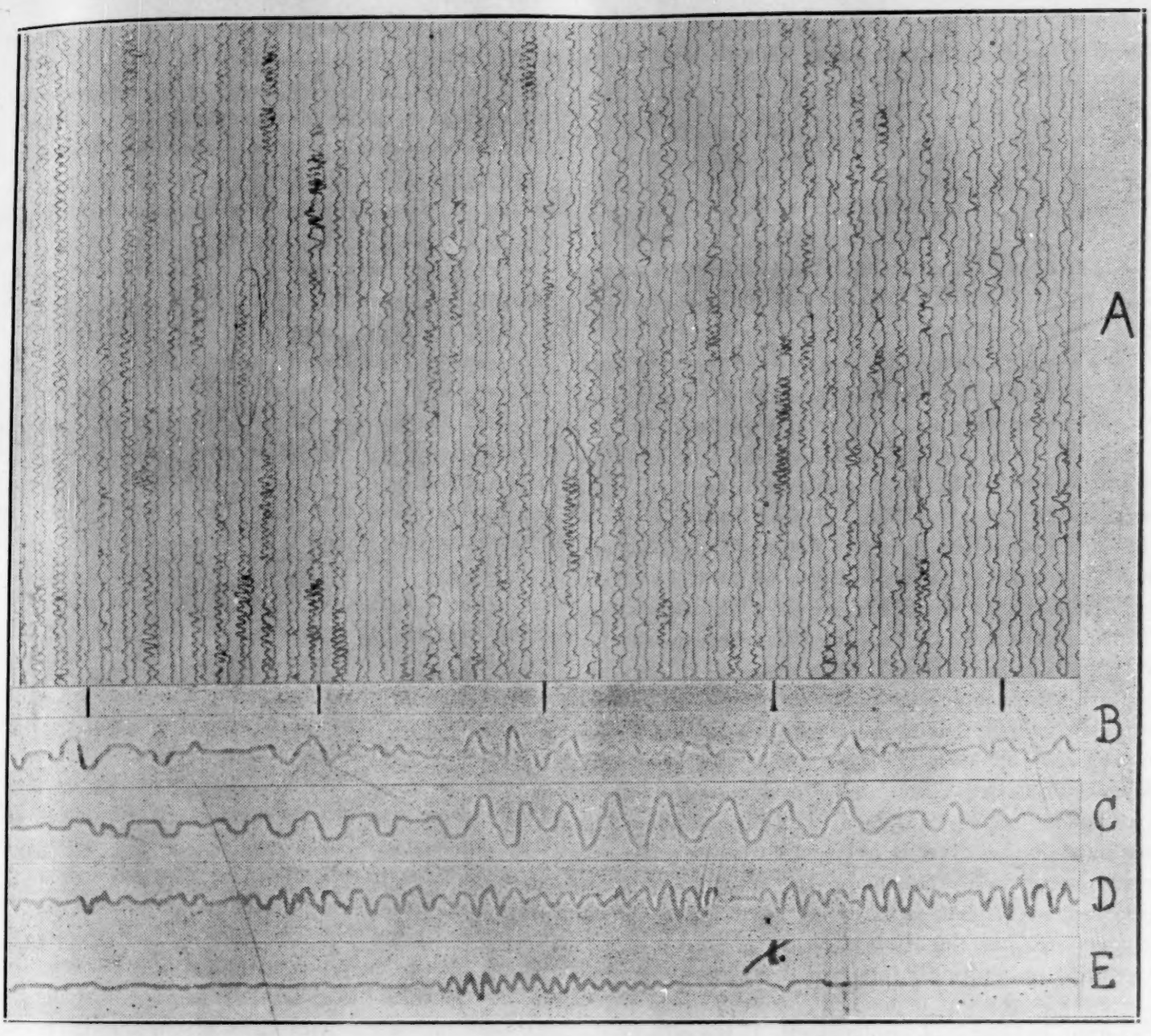

FIG. 1. A shows brain potential rhythms from two areas of the cortex. The photograph is a small section from a large continuous record taken on an eight-foot drum, 45 inches in circumference, revolving once a minute. The section shows only eight seconds out of each minute (time, in seconds, at left). Read from top to bottom and from left to right. The left line in each pair gives the potentials from the front area of the cortex, the right line the back area. B, C, D, E. Enlarged photographs of four types of waves which we have called (B) "random," (C) "saw-tooth," (D) "trains," (E) "spindles." Time in seconds at top of B (read left to right). Note in A the change in character of the waves from "trains" and "spindles" to the "random" type over the forty-five minute period. Note also how often the "trains" appear in one area and not in the other.

amplitude, frequency and time of appearance were observed between the rhythms from the front and back areas. This is also illustrated in Fig. 1-A. These observations seem to indicate that the individual rhythms arise in different regions of the cortex, but that the gradual change of type from "trains" to "random" is dependent on a change connected with the cortex as a whole.

We found also that the trains appearing as the result of sound stimuli sent to a sleeping subject were much more marked in the front area than in the back. This was at first unexpected, as the temporal cortical end station for auditory stimuli is as near or nearer the back area as the front, but would be readily understandable if trains were due to a change in level of consciousness in the front area, brought about by the sound disturbances.

While the foregoing observations apply to the great majority of the subjects so far studied, we have found a number whose brain rhythms were of quite special types. So far we have observed the "saw-tooth" type of wave only in children and only when they have just fallen asleep. A peculiar type of wave of large amplitude lasting from two to four minutes has appeared in subjects during deep sleep without any movement or change in pulse or respiratory rate. In animals (dogs, rats) types of waves have appeared quite different from any observed on human subjects. Deep anesthesia stopped the waves in a rat completely. They began again when the

anesthesia became less deep. We will reserve the discussion of these matters for a later paper.

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INTRANASAL OR GASTROINTESTINAL PORTAL OF ENTRY IN POLIOMYELITIS[1]

IN a recent issue of SCIENCE, Faber[2] reported data on 57 monkeys in which poliomyelitis virus had been introduced intranasally. His facts are admitted. He concluded that, since the virus passed through the brain stem and spinal cord from above downward, and because the virus was found present in all levels of the cord just before paralysis appeared, no explanation of the usually earlier and greater paralysis of the lumbar area was possible other than that offered by Fairbrother and Hurst,[3] *i.e.,* that the virus usually involves the anterior horn cells of the lumbar area because of greater susceptibility of these cells. Shall we deduce, then, that in cases with only bulbar poliomyelitis or only cervical horn cell involvement or only seventh nerve palsy the lumbar motor areas of these patients are not susceptible, or that in these particular patients the motor cells of those areas involved are more susceptible? How does one explain why the cervical enlargement is often hit later, *i.e.,* after the lumbar area has already become involved? With the theory of susceptibility, one would have to think that there are degrees of motor cell susceptibility depending upon location and involvement. If the cells of the lumbar area have such a high degree of susceptibility they should respond promptly to local injection of virus into the lumbar area of the experimental animal. But they do not thus respond, for even when the virus is injected directly into this enlargement, there is a delay before the disease is produced.[4]

I feel that in the monkey the disease results when two factors combine and the combination material destroys motor cells. One of these factors is monkey cord virus and the other is the toxic material produced in the animal's gut. In the human being the causative agent usually enters the digestive system "ready made," *i.e.,* it is already combined and capable of producing cell destruction immediately. All the vagaries of the disease both in the *M. rhesus* monkey and the human being, even the reason why the lumbar area seems usually to be first involved, are easily understood in the light of this theory. Much experimental and clinical work has been done that points to a relationship between the gastrointestinal tract, the sympathetic nervous system and the production of the experimental disease.[5] But ignoring this evidence, what else can be said? When virus is given either intracerebrally or intranasally, the experimental animal usually gets quadriplegia and dies. Poliomyelitis is thus produced, but even though this is poliomyelitis, *it is not the kind of poliomyelitis that is seen in the human being.* Our objective should be not only to produce the disease, but to produce it as it appears clinically. If we can produce poliomyelitis in the experimental animal in the same way as it is seen in the human being, it is plausible to suppose that the route taken to produce it in the monkey might be the same as that taken by the virus in the human being.[6,7]

Faber further states that the theory of gastrointestinal invasion has few remaining advocates since the very convincing study of Clark, Roberts and Preston.[8] The facts shown by these workers do not rule out the gastrointestinal tract as a probable portal of entry. Clark, *et al.,* put virus into the intestines of monkeys that are normally not susceptible to poliomyelitis, and they did not produce the disease. When one realizes that poliomyelitis virus acts almost like an enzymic catalyst with an obligate affinity for gray fibers and that the natural disease can be produced only when the axis cylinders of the gray fibers contact the virus and absorb it, it is easy to understand why these workers did not produce the disease. When I caused the virus to come in contact with these fibers, the disease was easily produced.[6]

The fact that intranasal inoculation is unsuccessful if the connection between the gray-fibered olfactory nerve and central nervous system is severed is interesting. However, transection of the olfactory nerve would be of importance only if such section made it impossible for us to produce the disease by the gastrointestinal tract.

If our theory as to the production of paralysis in the monkey is right then it is obvious that passive immune serum of great value can not be obtained by injecting monkeys with the virus alone. A high-titered antiserum was rapidly produced by injecting

[1] From the Department of Pediatrics, Western Reserve University, and the Division of Contagious Diseases, City Hospital, Cleveland, Ohio.

[2] H. K. Faber, SCIENCE, 82: 42, 1935.

[3] R. W. Fairbrother and E. W. Hurst, *Jour. Path. and Bact.,* 33: 17, 1930.

[4] J. A. Toomey, *Proc. Soc. Exp. Biol. and Med.,* 32: 1185, 1935.

[5] *Idem, Annals Int. Med.,* 8: 854, 1935. *Jour. Prev. Med.,* 6: 379 and 397, 1932. *Proc. Soc. Exp. Biol. and Med.:* 30: 1082, 1933; 31: 502, 680, 702, 1015, 1934; 32: 423, 869, 1935. *Am. Jour. Dis. Child.:* 45: 1211, 1933; 46: 730, 1933; 47: 573, 1934; 48: 30, 1934. *Jour. Inf. Dis.,* 54: 74, 1934.

[6] J. A. Toomey, *Proc. Soc. Exp. Biol. and Med.,* 31: 680, 1934.

[7] *Idem, Proc. Soc. Exp. Biol. and Med.,* 32: 628, 1935.

[8] P. F. Clark, D. J. Roberts and W. S. Preston, Jr., *Jour. Prev. Med.,* 6: 47, 1932.

a sheep with these combined factors—virus and enteric toxin[9]—and recently we have produced paralysis in a horse by injecting these combined elements.

JOHN A. TOOMEY

HEMORRHAGIC NECROSIS AND REGRESSION OF SARCOMA 180[1]

BACTERIAL substances capable of eliciting the phenomenon of local skin reactivity to bacterial filtrates in rabbits[2] produce, upon intravenous injection, hemorrhagic necrosis and regression of transplantable malignant tumors of guinea pigs,[3] mice and rats.[4] There is, however, a high death rate in animals thus treated.

In experiments on the phenomenon of local skin reactivity to bacterial filtrates in rabbits it was observed that, in certain proportions, mixtures of *B. typhosus* culture filtrates with homologous antisera possess a high phenomenon-producing and low lethal potency. Studies were then made on the effect of single intravenous injections of these mixtures and of toxic filtrates alone upon 132 mice bearing twelve days old sarcoma 180. Best results were obtained with a mixture of 300 *B. typhosus* reacting units with 200 neutralizing units of antityphoid horse serum[5] tested in 27 mice. There was no early mortality (*i.e.*, 24 hours after the intravenous injection). Late mortality (*i.e.*, 2 to 20 days after the intravenous injection) occurred in 5 mice. Prompt hemorrhagic necrosis took place in 23 mice and complete regression of tumors with uneventful healing in 21 of these mice. According to Woglom,[6] untreated mice show only 1.33 per cent. of spontaneous regressions. As the amount of filtrate in mixture with 200 neutralizing units of the serum was increased, there occurred early mortality and a roughly proportionate rise in late mortality. The incidence of complete regressions of tumors of surviving mice was approximately the same. Doses of 125 and 250 reacting units of the filtrate alone (*i.e.*, without the serum) elicited early mortality as high as 70 and 95 per cent., respectively.

It becomes obvious from these experiments that in certain proportions mixtures of *B. typhosus* filtrates with homologous antisera possess a comparatively low lethal potency and yet elicit prompt and intense hemorrhagic necrosis with subsequent complete regression of sarcoma 180 in a high percentage of mice well above normal expectancy. Further work is under way in order to determine the effect of these and other combinations of bacterial filtrates with immune antisera upon animal and human spontaneous tumors.

GREGORY SHWARTZMAN

[9] *Idem, Proc. Soc. Exp. Biol. and Med.*, 32: 1346, 1935.

[1] From the laboratories of The Mount Sinai Hospital, New York City. Preliminary report. This investigation has been aided by a grant from the Josiah Macy, Jr., Foundation.

[2] G. Shwartzman, *Jour. Exp. Med.*, 48: 247, 1928.

[3] Gratia and Linz, *C. R. Soc. Biol.*, 108: 427, 1932.

[4] G. Shwartzman and N. Michailovsky, *Proc. Soc. Exp. Biol. and Med.*, 29: 737–741, 1932; D. Duran-Reynals, *Proc. Soc. Exp. Biol. and Med.*, 31[1]: 341, 1933–34; K. Apitz, *Ztsch. f. Krebsforst.*, 40[1]: 50, 1933.

[5] G. Shwartzman, *Jour. Exp. Med.*, 52: 781, 1930.

[6] William H. Woglom, personal communication.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A THYRATRON CONTROL FOR INCUBATORS AND WATER BATHS

THE use of an electromagnetic relay for the control of heating elements in incubators and water baths has two fundamental disadvantages. (1) The current required to operate even highly sensitive relays is more than is desirable at the mercury platinum junction of the thermoregulator. This can be corrected by the use of an amplifying vacuum tube, but adds to the complexity of the set-up without avoiding the second disadvantage. (2) Any relay, no matter how well made, is apt to stick and possibly ruin an extensive experiment. This can be avoided by using a duplicate relay and thermoregulator, but again the system is complicated. These disadvantages are obviated by the use of a thyratron to replace the amplifying tube and relay. For this purpose we have used a General Electric Thyratron, FG154, which is a four-electrode, Argon-filled, low-grid current control tube. This tube is rated to carry a current of 2.5 amps. continuously, which is sufficient for the temperature control of most incubators and the average water bath. Under ordinary conditions, with currents not exceeding the maximum rated value, a tube may be expected to serve for at least one year. Another tube, FG98, capable of carrying .5 amps., is available for smaller incubators or temperatures near to that of the room.

The figure gives a wiring diagram of the set-up used. The tube has six terminals, four which fit into the base and are lettered F, F, P and G. F and F connect with the ends of the filament and P with its midpoint. G connects with the shield grid. The terminal of the control grid is at the side of the tube and the terminal of the anode at the top. The heating unit may be in any desired form. The filament transformer must be capable of delivering 35 watts at 5.0 volts A.C., and the filament current should be as nearly constant as possible to ensure a long life for the tube. The two batteries may be dry cells. The current drawn from them is so small that they may be expected to last approximately their "shelf life."

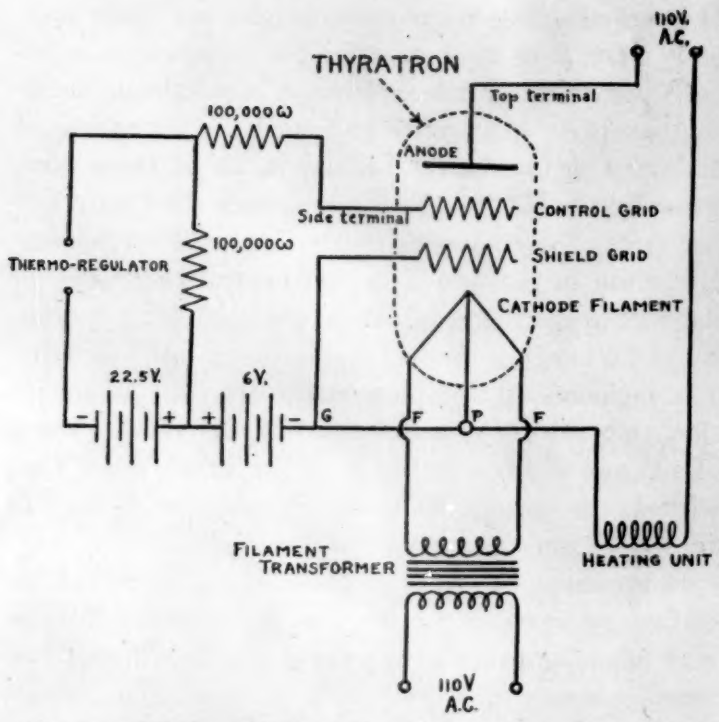

FIG. 1. Wiring diagram for thyratron control for incubators and water-baths.

The 100,000 ohm resistances are of the type commonly used for grid leaks in radio sets. The thermoregulator may be of any make-and-break type. The wiring diagram shown is such that when contact is made at the thermoregulator, the heating current is off and *vice versa*. Care should be taken that the filament current is turned on some fifteen seconds before the heating current comes into the circuit.

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THE PREPARATION OF BIXIN

THE dried seeds of *Bixa orellana,* a plant native to the West Indies, are known to contain much of the red pigment, bixin, as well as a little carotene and other materials.

Attempts to isolate this bixin by methods devised by Riffart,[1] Heiduschka and Panzer,[2] and van Hasselt[3] were quite unsuccessful in our laboratory, giving a very small yield. In order to obtain a good yield of pure crystalline material with the minimum of manipulation, the following method was developed:

A several hundred gram portion of Jamaica annatto seeds was ground in a nut-meat grinder and then allowed to stand in a large, wide-mouth, loosely corked bottle for two days to allow the coarse meal to dry. This coarse material was then further ground to a fine powder in a large laboratory mill and sifted through a 60-mesh sieve.

[1] Riffart, Dissert., München, 1911.
[2] A. Heiduschka and A. Panzer, *Ber.*, 50: 546, 1917.
[3] van Hasselt, Dissert., Delft, 1910.

About 250 grams of this pulverized annatto w treated with a liter and a half of cold acetone in three-liter flask for fifteen to twenty minutes, the mi ture being agitated every few minutes. The deep colored (red-brown) acetone solution w then d canted and discarded because of the large amount oily and resinous material that it contained. T remaining solid was extracted repeatedly with on liter portions of boiling acetone until the color of t solid residue was a pale yellow when dry. The co bined acetone extractions were filtered and then evap rated to about one tenth their former volume, whe upon there was precipitated a mass of metalli lustrous purple crystals. With a sufficiently lar Soxhlet extraction apparatus, the rather large to volume of acetone was much diminished. (The a tone reclaimed in the process of evaporating t decanted and filtered acetone solution may be used further extraction of the raw material.)

The final volume, now one tenth of the total volum was cooled and the precipitated crystalline materi filtered therefrom. This crystalline material was cru bixin. It was suspended in about a liter of purifi dry acetone and refluxed for a period of an hour order to saturate the acetone at the boiling point. T hot solution was quickly filtered through a hot-wat funnel to remove the undissolved material, and t resulting filtered solution rapidly cooled, first at roo temperature and then in an ice-salt mixture. T resulting crystals were deep purple in color and po sessed a bright metallic luster. Microscopic examin tion showed individual crystals to be rhombic in shap and a deep red color by transmitted light. Whe slowly heated, the crystals melted at 192° C. Treate with concentrated H_2SO_4, the crystalline materi even minute traces, dissolved to give a blue solutio The crystalline material was readily soluble in alka The crude bixin, which was about 4.5 per cent. of t annatto powder, was converted into purified bix crystals with a yield of about 3.5 per cent.

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BOOKS RECEIVED

CONDON, E. U. and G. H. SHORTLEY. *The Theory o Atomic Spectra.* Pp. xiv + 441. Cambridge Universit Press, Macmillan. $11.00.

GRAUBARD, MARK. *Genetics and the Social Order.* P 128. Tomorrow, Publishers. $0.75.

GROVE, W. B. *British Stem- and-Leaf-Fungi. Vol. I Sphaeropsidales.* Pp. xx + 488. 31 figures. Cambridg University Press. Macmillan. $7.00.

HAGEDORN, HERMANN. *The Magnate: The Story of Wi liam Boyce Thompson.* Pp. viii + 343. Illust Reynal & Hitchcock, New York. $3.00.

VISSCHER, MAURICE B. *Experimental Physiology.* P 191. 75 figures. Lea & Febiger. $3.25.